Radiology Reports for Incidental Thyroid Nodules on CT and MRI: High Variability across Subspecialties

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ABSTRACT

BACKGROUND AND PURPOSE: Variability in radiologists' reporting styles and recommendations for incidental thyroid nodules can lead to confusion among clinicians and may contribute to inconsistent patient care. Our aim was to describe reporting practices of radiologists for incidental thyroid nodules seen on CT and MR imaging and to determine factors that influence reporting styles.

MATERIALS AND METHODS: This is a retrospective study of patients with incidental thyroid nodules reported on CT and MR imaging between January and December 2011, identified by text search for "thyroid nodule" in all CT and MR imaging reports. The studies included CT and MR imaging scans of the neck, spine, and chest. Radiology reports were divided into those that mentioned the incidental thyroid nodules only in the "Findings" section versus those that reported the incidental thyroid nodules in the "Impression" section as well, because this latter reporting style gives more emphasis to the finding. Univariate and multivariate analyses were performed to identify radiologist, patient, and nodule characteristics that influenced reporting styles.

RESULTS: Three hundred seventy-five patients met the criterion of having incidental thyroid nodules. One hundred thirty-eight (37%) patients had incidental thyroid nodules reported in the "Impression" section. On multivariate analysis, only radiologists' divisions and nodule size were associated with reporting in "Impression." Chest radiologists and neuroradiologists were more likely to report incidental thyroid nodules in the "Impression" section than their abdominal imaging colleagues, and larger incidental thyroid nodules were more likely to be reported in "Impression" ($P \leq .03$). Seventy-three percent of patients with incidental thyroid nodules of ≥20 mm were reported in the "Impression" section, but higher variability in reporting was seen for incidental thyroid nodules measuring 10–14 mm and 15–19 mm, which were reported in "Impression" for 61% and 50% of patients, respectively.

CONCLUSIONS: Reporting practices for incidental thyroid nodules detected on CT and MR imaging are predominantly influenced by nodule size and the radiologist's subspecialty. Reporting was highly variable for nodules measuring 10–19 mm; this finding can be partially attributed to different reporting styles among radiology subspecialty divisions. The variability demonstrated in this study further underscores the need to develop CT and MR imaging practice guidelines with the goal of standardizing reporting of incidental thyroid nodules and thereby potentially improving the consistency and quality of patient care.

ABBREVIATION: ITN = incidental thyroid nodule

Incidental thyroid nodules (ITNs) are a common radiologic finding, seen in 1 in 6 patients undergoing CT and MR imaging examinations of the neck.[1,2] Unlike nodules seen on sonography, there are no reliable signs of malignancy and no well-accepted guidelines for reporting ITNs detected on CT and MR imaging. Consequently, the current practice of reporting thyroid nodules on CT and MR imaging by radiologists is highly variable.[3] Some radiologists may report all ITNs because there is a chance that an ITN could be malignant. Other radiologists may not report any ITNs because thyroid cancers in ITNs are relatively uncommon[4] and small thyroid cancers often have an indolent course.[5,6] In particular, reporting an ITN in the "Impression" section of a radiology report provides more emphasis of the finding and may increase the chance of further work-up.

Different recommendations for patients with the same nodule characteristics and clinical history are problematic because they can lead to variation in practice patterns, potential variation in the quality of patient care, and anxiety for patients, and they can po-

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tentially increase health care costs from the performance of more imaging studies, biopsies, and diagnostic surgeries.[2,7-9] Although some incidental cancers may be diagnosed and treated at an earlier stage, >50% of patients with ITNs that have surgery will ultimately be diagnosed with benign disease.[10,11]

The variation in reporting styles for ITNs seen on CT and MR imaging has been measured in a recent study, which surveyed radiologists on how they reported different scenarios varying in nodule size and patient history.[3] The study demonstrated high variability of ITN reporting, with an overall mean agreement in reporting style of 53% and lower rates of agreement for smaller nodules. A limitation of a survey, however, is that it may not accurately reflect what a radiologist actually does in practice. Another study evaluated reporting practices for ITNs based on radiology reports for cervical spine CT.[12] The authors found that recommendations for ITNs are made inconsistently and the type of management recommended is variable. However, variability in reporting may have been underestimated in their study because it was limited to CT reports issued only by emergency radiologists and did not encompass the reporting practices of abdominal, chest, and neuroimaging radiologists. In addition, the authors did not differentiate between ITNs reported in the "Impression" section of the report versus only the "Findings" section. To fully examine variability in reporting of ITNs, a study should evaluate the reporting style, encompass all radiology subspecialties, and include all CT and MR imaging studies that may lead to detection of ITNs.

The purpose of this study was to describe the reporting practices of radiologists for ITNs seen on CT and MR imaging and to determine the factors associated with reporting ITNs in the "Impression" section of the radiology report. We hypothesized that reporting styles would be influenced not only by nodule and patient characteristics but also by radiologist-specific factors, such as subspecialty training and years of experience. Understanding factors associated with variation in reporting practices among radiologists may help to standardize practice patterns, and demonstration of highly variable practices would support the need for guidelines for reporting ITNs seen on CT and MR imaging.

MATERIALS AND METHODS

Study Group

This was a retrospective study of 401 patients with thyroid nodules reported on CT or MR imaging between January 1, 2011, and December 31, 2011, at a single large academic institution with 8 subspecialty clinical divisions and 59 subspecialty radiologists. Patients were identified by performing a text search of CT and MR imaging reports for the phrase "thyroid nodule" by using the Duke Enterprise Data Unified Content Explorer, a Web application for cohort identification and data extraction. The search encompassed all CT and MR imaging examinations performed during the time of interest regardless of the body part/region imaged. The studies included CT and MR imaging of the neck, spine, and chest. To capture only ITNs, we excluded patients if the imaging study was performed to evaluate the thyroid, if they had prior evaluation of the thyroid (such as previous thyroid sonography or biopsy), or if they had a personal history of thyroid cancer. The study was approved by our institutional review board. Written informed consent was waived by the institutional review board.

Reporting Style

Reports were analyzed by 2 radiologists, each with 4 years' experience, to determine the reporting style and factors that could influence the reporting style. The primary reporting style of interest was whether the nodule was reported in the "Impression" section of the report (versus only in the "Findings" section) because this action by the radiologist will highlight the finding to the clinician and is more likely to result in subsequent evaluation. Reports were also categorized on the basis of whether the radiologist specifically recommended further work-up with another examination, such as a thyroid sonography.

Factors Associated with Reporting Styles

Data were collected on factors that could influence reporting styles and included characteristics of the radiologists, patients, and nodules. Radiologist characteristics included years of experience after completion of training and radiology subspecialty division (chest imaging, abdominal imaging, neuroradiology, other). At our institution, diagnostic thyroid sonography and sonography-guided thyroid biopsy are performed by abdominal radiologists. Patient characteristics included sex and age and the study indication. Study indication was obtained directly from the dictated radiology report and was categorized into 1 of 5 groups: malignancy, trauma, nontraumatic vascular pathology, inflammation/infection, and other indication. Nodule characteristics consisted of size, morphology (calcified, cystic, hyperenhancing), and the presence of other nodules. Nodule sizes were obtained directly from the reports, and the longest reported dimension was recorded. For statistical analyses, an ITN reported as "subcentimeter" was converted to continuous data by assigning it a size of 8 mm. Eight millimeters was chosen because an ITN of <5 mm is less likely to be clearly seen on CT and MR imaging, while an ITN close to 10 mm would more likely be reported as a 10-mm nodule. Thus, 8 mm was chosen for the purpose of data analysis because it lies between 5 and 10 mm.

Outcome Measures and Statistical Analysis

We calculated the proportion of ITNs reported in the "Impression" section of the report and recommended for further evaluation. Patients with ITNs reported in the "Impression" section were compared with those with ITNs reported only in the "Findings" section of reports. Patients with ITNs recommended for work-up were compared with those without work-up recommendations. Either a χ^2 test or Fisher exact test was used for testing differences in these patients for categoric variables. The unpaired *t* test was used to test for differences for continuous variables. A multivariable logistic regression model was fitted to identify factors that were associated with ITNs that were reported in the "Impression" sections of reports and recommended for further evaluation. A *P* value < .05 was considered statistically significant.

Data were entered into an Excel spreadsheet (2007; Microsoft, Redmond, Washington). Statistical analyses were performed by using the SAS Enterprise Guide (Version 4.2; SAS Institute, Cary, North Carolina).

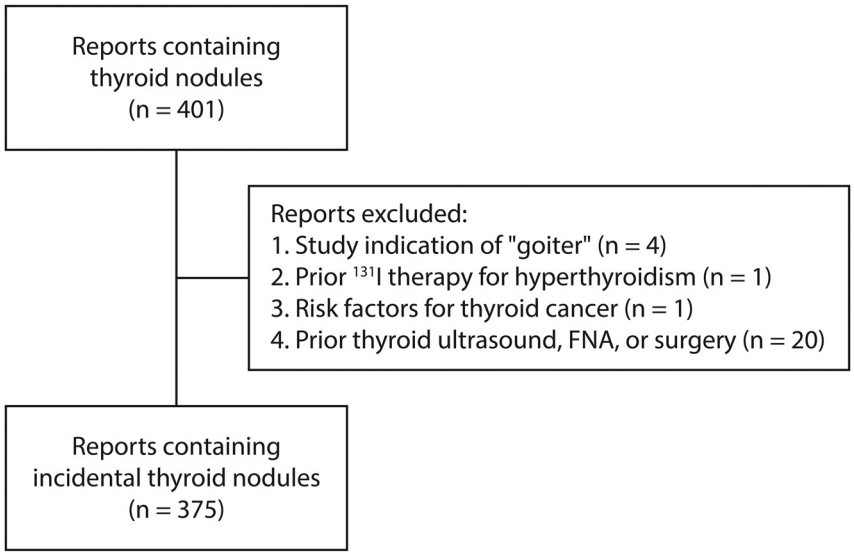

FIG 1. Flowchart of study patients. FNA indicates fine needle aspiration.

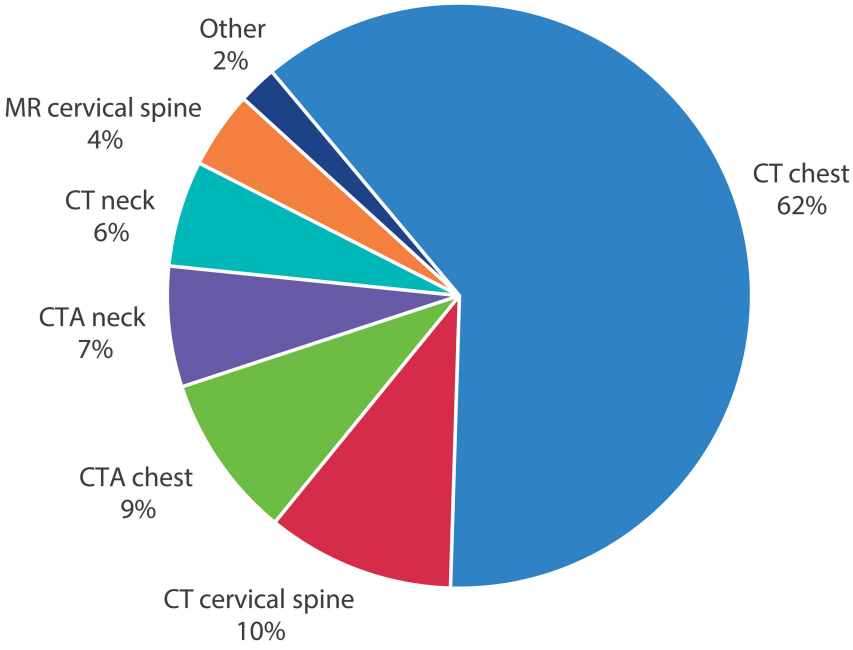

FIG 2. Source of imaging studies with reported incidental thyroid nodules.

RESULTS

Study Group

Three hundred seventy-five patients met the inclusion criteria of having ITNs in their radiology reports and no history of thyroid pathology (Fig 1). The mean patient age was 64 ± 14 years, and 250 (67%) patients were women (On-line Table). CT was the most common source of ITN detection and accounted for 353 (94%) patients, compared with 22 (6%) patients with ITNs on MR imaging studies (Fig 2). In patients who had ITNs discovered on CT, 231 (65%) were identified on chest CT, followed in frequency by cervical spine CT (n = 39, 11%) and chest CT angiography (n = 34, 10%). The most common study indication for CT or MR imaging was evaluation of malignancy (52%).

Reporting Style

One hundred thirty-eight of 375 (37%) patients had ITNs reported in the "Impression" sections of their reports, while 237 (63%) had ITNs reported only in the "Findings" section (On-line Table). No reports contained ITNs in the "Impression" without the ITNs also being described in the "Findings" section. All reports had both "Findings" and "Impression" sections. Sixty-nine of 375 (18%) patients had ITNs recommended for further work-up (On-line Table). There were no recommendations for investigations other than sonography.

Factors Associated with Reporting in the Impression Section

Univariate analysis found radiology division, study indication, and nodule size to be significantly associated with ITNs reported in the "Impression" sections of reports (P values $< .0001$) (On-line Table). Radiologist experience was not significantly associated with reporting ITNs in the "Impression" section. However, we observed that radiologists with 5–9 years' experience were less likely to report ITNs in the "Impression" (29%) than those with 0–4 years' experience (35%) and >10 years' experience (42%). On multivariate analysis, only radiology division and nodule size remained significant ($P \leq .03$).

Abdominal division radiologists were less likely to report ITNs in the "Impression" section of the report than radiologists in other divisions. ITNs were reported in the "Impression" section in 23% of the studies interpreted by abdominal radiologists compared with 43% for chest radiologists and 50% for neuroradiologists (On-line Table).

Larger nodules were more likely to be reported in the "Impression" sections of reports. The mean nodule size was 16.9 ± 9.8 mm for ITNs reported in the "Impression" compared with 15.4 ± 7.4 mm for ITNs not reported in the "Impression" section (On-line Table).

On subgroup analysis of nodule sizes, there was higher variability in reporting styles for ITNs measuring between 10 and 19 mm than for other sizes. Sixty-one percent of 10- to 14-mm nodules and 50% of 15- to 19-mm nodules were reported in the "Impression" (On-line Table and Fig 3). In contrast, there were less variability and more agreement in reporting styles for larger nodules and subcentimeter nodules. Seventy-three percent of ITNs of ≥20 mm and only 30% of ITNs <10 mm were reported in the "Impression" section. Notably, 185 (49%) reports did not provide the nodule size, including 42 patients with ITNs reported in the

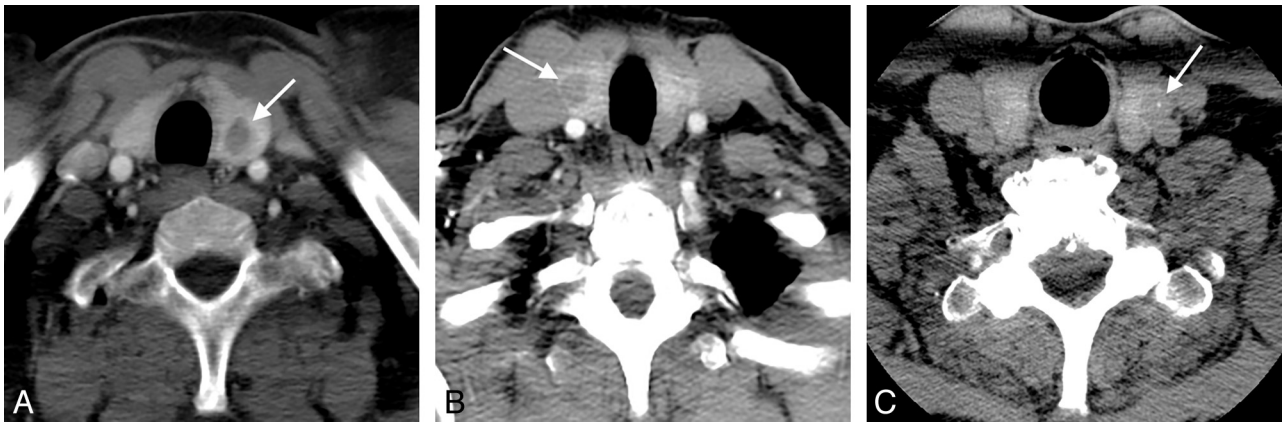

FIG 3. Three patients with incidental thyroid nodules that were similar in size but were reported differently. *A*, A 46-year-old man with a 12-mm incidental nodule in the left thyroid lobe detected on chest CTA performed to evaluate an abdominal aortic aneurysm. The nodule was reported only in the "Findings" section of the report without a recommendation. *B*, A 47-year-old woman with a 10-mm incidental nodule in the right thyroid lobe detected on chest CTA performed to evaluate chest pain. The nodule was reported in the "Impression" section without a recommendation. *C*, A 63-year-old man with several incidental thyroid nodules detected on cervical spine CT performed to evaluate neck injury. The largest was in the left thyroid lobe and measured 10 mm. The nodule was reported in the "Impression" section with a recommendation for sonography.

The Duke 3-tiered system for CT, MRI, or PET-detected thyroid nodules[1,13,14,a]

Category	Criteria for Categories	Recommendations
Risk category 1: highly suspicious for malignancy	PET avid thyroid nodule Suspicious lymphadenopathy;[b] extrathyroid spread with or without signs of vocal cord palsy on side of nodule; lung metastases	Strongly consider work-up with ultrasound for any size nodule
Risk category 2: indeterminate with risk factor of young age	Age younger than 35 years	Consider work-up with ultrasound if ≥1 cm in adults Consider work-up with ultrasound for any size in pediatric patients
Risk category 3: indeterminate without risk factors	Age 35 years or older	Consider work-up with ultrasound if ≥1.5 cm

[a] Intended for management of incidental thyroid nodules in low-risk patients.
[b] Suspicious lymph nodes are defined as nodes >10 mm in the short axis (with the exception of jugulodigastric lymph nodes, which are permitted to be up to 15 mm in the short axis) or nodes that contain either calcifications, cystic components, or irregular margins.

"Impression" section of reports and 17 patients with recommendations for sonography.

Factors Associated with Recommendations for Further Work-Up

For factors that influenced recommendations for work-up, univariate analysis found radiology division, radiologist experience, and study indication significantly associated with ITNs recommended for work-up ($P \leq .03$) (On-line Table). On multivariate analysis, study indication and radiology division remained significant ($P < .05$).

Abdominal division radiologists were less likely to recommend work-up for ITNs than those in other divisions. Only 6% of reports generated by abdominal radiologists had recommendations for additional work-up, compared with 32% by chest radiologists and 24% by neuroradiologists (On-line Table). Although radiologist experience did not significantly influence recommendations on multivariate analysis, on univariate analysis, radiologists with 5–9 years' experience were much less likely to recommend further work-up (10%) than those with 0–4 years' experience (17%) and >10 years' experience (24%).

Patients undergoing imaging for another malignancy were less likely to have recommendations for additional work-up of ITNs. Additional work-up for ITNs was recommended in 7% of patients with known malignancy compared with 31% of patients having imaging for other indications (On-line Table).

DISCUSSION

Variability in reporting styles and recommendations for ITNs by radiologists can lead to confusion among clinicians and may contribute to inconsistent patient care. Ideally, recommendations in radiology reports should be uniform, and factors that influence further evaluation should be based only on nodule and patient characteristics. This study demonstrates that there is high variability for reporting of ITNs measuring 10–19 mm on CT and MR imaging, and that the subspecialty of radiologists is a major factor associated with ITNs being reported in the "Impression" section, independent of nodule size. This finding implies that the high variability in reporting styles is partially due to different practices among subspecialty radiologists.

Our study found that abdominal imaging radiologists were less likely to report ITNs in the "Impression" section of reports and were also less likely to specifically recommend work-up. There are 2 possible reasons for this finding. First, abdominal imaging radiologists are often reading CT examinations covering multiple body parts (such as the chest, abdomen, and pelvis) that may contain many significant findings. Small ITNs may be con-

sidered less important relative to other abnormalities and, therefore, are not included in the "Impression" section of the reports. Second, at our institution, abdominal imaging radiologists perform sonography-guided thyroid biopsies and observe firsthand the high number of benign biopsies, potentially making them less apt to recommend further work-up.

Another radiologist characteristic that was studied was years of experience. A prior study found that the overall rate of recommending additional imaging decreased as radiologists' experience increased.[8] However, we did not observe this trend. In fact, the more experienced radiologists were most likely to report ITNs in the "Impression" section and recommend work-up, and radiologists with 5–9 years' experience were least likely to report ITNs in the "Impression" and recommend work-up. We believe this finding reflects the high baseline variability in ITN reporting irrespective of experience level and that a more influential factor is the tendency for radiologists to utilize a reporting style that is similar to others within their own local subspecialty group.

Lehnert et al[12] also retrospectively evaluated recommendations made in radiology reports for ITNs. Their study was limited to a subset of CT cervical spine scans reported by emergency radiologists, but it did highlight several deficiencies in current radiology reporting practices that are also present in our study. Our study and that of Lehnert et al found that a large proportion of ITNs did not have nodule size described anywhere in the report (49% and 23%, respectively). Size is a significant factor in the decision to further evaluate ITNs; therefore, it is an important feature to describe if the nodule warrants mentioning in the report. Additionally, recommendations were not commonly included in radiology reports. In our study, recommendations were not provided for half of the patients with ITNs reported in the "Impression" section. In the study of Lehnert et al, 43% of ITNs had no management recommendations. Some may argue that recommendations may not be necessary; however, this argument assumes that the clinician recognizes the significance of ITNs and is familiar with their work-up.

Our study also identified highly variable reporting practices for nodules measuring between 10 and 19 mm. These results concur with findings from a survey on how radiologists report ITNs on the basis of scenarios differing in patient age, sex, and nodule size.[3] In this survey, the scenario with the highest variability in responses was that of a 60-year-old woman with a 10-mm ITN: Thirty-six percent of radiologists thought that the nodule should be left in the "Findings" section and not receive work-up, while 35% of radiologists would recommend additional work-up with sonography and 21% would report the nodule in the "Impression" without a recommendation.[3] In our study, which evaluated actual reporting practices, the practices seen in radiology reports for 10- to 19-mm nodules were also almost equally split: Sixty-one percent of ITNs measuring 10–14 mm and 50% of those measuring 15–19 mm were reported in the "Impression." This high variability suggests that radiologists are less certain of how to manage ITNs measuring 10–19 mm than they are for ITNs <1 cm or >2 cm, and this size range appears to be one for which future guidelines have the potential to significantly improve reporting consistency.

Although there are not yet any official guidelines from the professional societies within radiology, a categorization method for ITN discovered on CT, MR imaging, and PET/CT has been proposed and is known as the 3-tiered system (Table).[1,13,14] The 3-tiered system is based on nodule size, patient age, and suspicious imaging findings. Two retrospective studies found that the 3-tiered system had the potential to reduce radiographic and endocrinologic work-up by 35%–46% without missing a malignancy.[1,14] In addition to reducing the costs, patient anxiety, and additional procedures that are associated with unnecessary ITN work-up, the advantage of such a system is standardization of radiology reporting and recommendations. From a medical-legal perspective, guidelines would also serve as a resource for radiologists when facing the dilemma of whether and how to report incidentalomas.[15]

There are several limitations to this study. First, this is a retrospective study performed at a single institution, and these results may not be generalizable to all radiology practices, particularly smaller, less subspecialized ones. We know that on the basis of prior survey results, radiologists at our institution describe fewer ITNs in the "Impression" section of their reports.[3,16] In a published survey, a 15-mm nodule in a 60-year-old woman would be reported in the "Impression" section (with or without recommendation) by 78% of respondents[3]; in our study, 50% of nodules 15–19 mm were actually reported in the "Impression." In the survey, a 10-mm nodule in a 60-year-old woman would be reported in the "Impression" section (with or without recommendation) by 56% of respondents; in our study, 50% of nodules measuring 10–14 mm were actually reported in the "Impression." While ITNs may be reported differently at other institutions depending on their size and practice type,[3] demonstrating variability even within 1 institution highlights the problem of not having guidance on managing ITNs.

Second, the text report search used likely underestimated the number of incidental thyroid findings by only searching for the phrase "thyroid nodule" and not including other related terms. However, using this single search term provided a sufficient sample size during the 12-month study period, and we do not believe that including all incidental thyroid findings would necessarily alter the results. Third, nearly half of reports did not include a description of the nodule size and were therefore excluded from the analyses examining the relationship between nodule size and reporting style. However, these nodules were included in the univariate analyses of other factors influencing reporting style. Finally, we did not verify the findings reported in the radiology reports by reviewing the images, nor did we examine other studies performed during the time of interest to identify patients who had ITNs on imaging that were overlooked or not reported by the radiologist. Because our aim was to study the factors that influenced reporting, it was only what the radiologist saw and interpreted that was relevant. Finally, we did not evaluate the outcomes of the reporting styles and recommendations because we were focused on radiologist reporting practices. These could be a topic of future study.

CONCLUSIONS

One in 3 patients with ITNs detected on CT or MR imaging has a thyroid nodule reported in the "Impression" section of the report, and half of these patients have recommendations for additional

evaluation. Whether an ITN is reported in the "Impression" versus left in the "Findings" section is predominantly influenced by the nodule size and the radiologist's subspecialty. The variability demonstrated in this study further underscores the need to develop CT and MR imaging practice guidelines that can be used by all radiologists, with the goal of standardizing reporting of ITNs and thereby potentially improving the consistency and quality of patient care.

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